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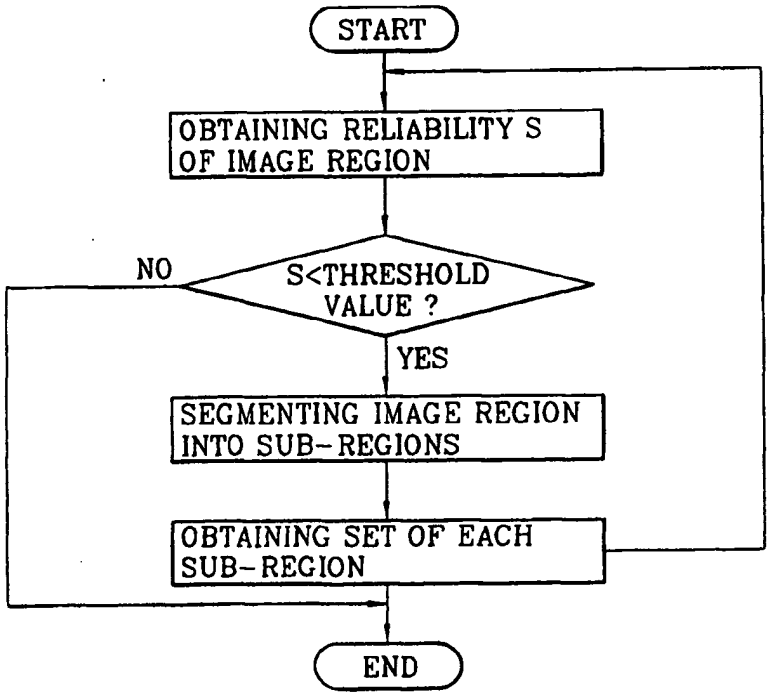
(54) Title: REPRESENTATIVE COLOR DESIGNATING METHOD USING RELIABILITY

(57) Abstract

A method for designating a representative color which is expressed based on a reliability that a representative color of an image region expresses an image region is disclosed. This method includes a step for expressing a reliability of the representative color value as a color information of the image region together with a representative color value which represents the image region in a method using a color value as an information with respect to an image region, for thereby expressing a color information of an image region using a reliability and a color segmentation method of an image region.



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REPRESENTATIVE COLOR DESIGNATING METHOD USING RELIABILITY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a representative color value designating method for an image search system, and in particular to a method for designating a representative color of an image region by expressing a representative color value with respect to an image region together with a reliability which represents an accuracy of the representative color, and to a method for measuring a similarity of more than two images and a method for segmenting an image into similar regions using a feature of a representative color value expressed together with the reliability.

2. Description of the Background Art

In an image search technique, a color information used for an image search is an important factor in the characteristic of images.

In a conventional art, there is a method in which an image is segmented into a nxm number of grids, and a color histogram is obtained with respect to each segmented cell, and a maximum value of the thusly obtained color histogram is determined as a representative color value with respect to a corresponding cell. In another method, an average value of the color histogram is determined as a representative color value of a corresponding cell. In another method, a major color vector is obtained and determined as a representative color value for a corresponding cell.

However, since the characteristics of the images are various, it is difficult to express an image using a color in an image region or one color value. It is improper to express a feature of an image by expressing the image region using one representative color value information. In this case, it is difficult to form an accurate database using the characteristics of images, and the performance of an image search using the thusly formed database is decreased. Furthermore, when expressing a representative color of an image region using various colors instead of one color, a large storing space is required. In addition, it is difficult to accurately express an interrelationship between various colors. Therefore, a representative color value of the thusly determined image region has a low accuracy.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a method for designating a representative color which is expressed based on a reliability that a representative color of an image region expresses an image region.

It is another object of the present invention to provide a method for expressing a color information of an image region using a reliability and a color segmentation method of an image region.

It is still another object of the present invention to provide a representative color designating method which may be used for an image search based on a weight in accordance with a reliability.

To achieve the above objects, there is provided a representative color designating method which comprises a step for expressing a reliability of the

representative color value as a color information of the image region together with a representative color value which represents the image region in a method using a color value as an information with respect to an image region.

Additional advantages, objects and features of the invention will become more apparent from the description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Figure 1 is a flow chart of a representative color designating method using a reliability according to the present invention;

Figure 2 is a flow chart of a method for obtaining a reliability using a color similarity according to the present invention;

Figure 3 is a flow chart of a method for obtaining a color similarity according to the present invention;

Figure 4 is a flow chart of a method for obtaining a reliability using a mixed rate and color similarity according to the present invention;

Figure 5 is a flow chart of a method for obtaining a mixed rate according to the present invention;

Figure 6 is a flow chart of a method for obtaining a frequency of a color pixel which has a chrominance exceeding a certain threshold value in an image region according to the present invention;

Figures 7 and 8 are views illustrating an example of a method for searching a presence of a corresponding color by adapting an expansion mask to an image region for thereby obtaining a mixed rate according to the present invention;

Figure 9 is a flow chart of a method for designating a representative color value using a reliability according to the present invention;

Figure 10 is a flow chart of a method for designating a representative color value using a reliability in an image region according to the present invention;

Figure 11 is a view illustrating a result(data structure) of a representative color designation of an image region expressed together with a reliability according to the present invention;

Figure 12 is a flow chart of a method for setting a representative color value and a reliability of each cell of a grid of an image region according to the present invention;

Figure 13 is a flow chart of a method for obtaining a color similarity between two image grids with respect to two regions according to the present invention;

Figure 14 is a view of a result of a representative color designation of an image region which is expressed by a reliability together with a representative color value having a certain degree reliability according to the present invention; and

Figure 15 is a flow chart of a method for obtaining a similarity region in which an image region is properly segmented using a reliability according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is directed to a method for designating a representative color of an image color based on a reliability that a representative color accurately expresses an image region when designating a representative color with respect to a certain image region. In addition, the present invention is directed to a method for determining a reliability in accordance with a mixed rate and color similarity of colors of an image region.

In addition, the present invention is directed to a method for obtaining a similarity between images by comparing a representative color and reliability of each cell with respect to more than two image regions by obtaining a representative color and reliability with respect to each grid cell after segmenting an image region into multiple grids.

Furthermore, the present invention is directed to a color segmentation method for segmenting an image into regions having the same color in accordance with a reliability degree by expressing a representative color and reliability of an image region.

The embodiments of the present invention will be explained with reference to the accompanying drawings.

Figure 1 is a flow chart of a representative color designating method using a reliability which includes a step for obtaining a reliability of an image region, a step for setting the thusly obtained reliability with respect to the image region as a reliability of the above-described region, and a step for setting a representative color value of the image region together with the reliability.

In the present invention, the reliability is an information representing an accuracy of a color value representing a certain region for an entire image or a certain portion within the image and is a value on whether a certain region expresses one color and is an accuracy when a corresponding region is expressed by the color and has a value between 0 and 1.

Therefore, assuming that the image region is formed of one color and the color is designated as a representative color of the region, the reliability of the representative color is 1. While, if the image region consists of different clear colors and one color among the different clear colors is designated as a representative color, the reliability becomes 0.

In addition, even when an image is formed of various colors, if the colors are properly mixed, the colors may be seen like one color. For example, blue colors and red colors are properly mixed in an image region, the thusly mixed colors may be seen like a purple color. Even when the colors are nor properly mixed, in this case, when an image is formed of similar colors, one color among the above-described colors may be designated as a representative color. When the thusly designated representative color may represent the image, the reliability with respect to the representative color is enhanced. For example, even when various yellow color groups are not properly mixed, a certain yellow color group may be designated as a representative color.

Therefore, in the present invention, the reliability is set based on a value which is determined in accordance with the mixed rate and color similarity of the colors in the image region. The method for obtaining the reliability will be explained later with reference to Figures 2 through 8. When expressing the representative color value of the image region with the reliability, the

representative color value may be used for searching the images based on the weights. In addition, it is possible to perform a color segmentation using the reliability. The description thereon will be provided later with reference to Figures 11 through 15.

Two methods are disclosed for obtaining a reliability in the present invention. One method is directed to removing a mixed element based on an averaging process of the image region and obtaining a reliability in accordance with the color similarity. The other method is directed to obtaining an accurate value of the mixed rate and obtaining a reliability based on the color similarity.

The first embodiment of the present invention for obtaining a reliability of the image region will be explained with reference to Figures 2 and 3. The mixed element is removed by the averaging process of the image region, and then the reliability is obtained based on the color similarity.

In the embodiments of the present invention, the image region is assumed as a rectangular region. Otherwise, the above-described methods possibly be adapted by considering the boundary portion.

The image region is changed to an image having a lower resolution. At this time, an average value of the nxn square pixel color values is obtained, and the nxn square pixels are changed to one pixel having an average color value, or the image region is filtered using the nxn average filter to obtain the same result. In the earlier method, errors occur, but the processing speed is fast. In the later method, the values are accurate but the processing speed is slow.

When performing the averaging process, the number of colors existing in the image region is decreased after the averaging process, so that any effects of the mixed elements are removed.

In the first embodiment of the present invention, the color similarity C-Sim is obtained after the averaging process is performed, and the thusly obtained value is set as a reliability value of the image region, and then the reliability is obtained.

The method for obtaining the color similarity C-Sim will be explained with reference to Figure 3.

First, an average color value is obtained with respect to all pixels of the image region. A hue(Hue_av), light(L_av), chrominance(Ch_av) are obtained with respect to the average color. In addition, all color pixels of the image region are changed to hue, light, chrominance elements, and then the average of the hue, light, chrominance elements is obtained. In this case, a result thereof is same.

The hue, light, chrominance elements with respect to the average color of the image region are obtained, and then the color of each pixel is changed into hue(H_i), light(L_i), chrominance(Ch_i) elements with respect to each pixel Pi of all pixels, and the distance(hereinafter color difference) in a color coordinate space is obtained between the values (H_i, L_i, Ch_i) and the average values (H_av, L_av, Ch_av), and the color differences are summed up to the last pixel.

The thusly summed color difference becomes sum of all the color difference value between each pixel and an average color. The summed color difference value is normalized to 0 through 1, and a result value obtained by subtracting the normalized value from 1 becomes a color similarity C_Sim.

In the first embodiment of the present invention, the thusly obtained color similarity value C-Sim is the reliability. Here, any color coordinate spaces which is used for obtaining the color similarity C-Sim may be available. As the color

coordinate space is uniformly changed along with the human color perception, the value obtained based on the color coordinate space becomes a relatively accurate value.

Next, the second embodiment of the present invention for obtaining a reliability will be explained with reference to Figures 4 through 6. In the second embodiment of the present invention, an accurate value of the mixed rate is obtained, and then the reliability is obtained based on the color similarity.

Figure 4 is a view illustrating a method for obtaining a reliability based on a mixed rate Mix_Rate and a color similarity C_Sim. The reliability is represented as follows:

$$Reliability = Mix\_Rate+(1-Mix\_Rate)(C\_Sim) \quad \text{---} \quad (1)$$

where Mix_Rate is a value between 0 and 1.

Namely, the value of the mixed rate Mix_Rate becomes 1, the reliability of Equation 1 is determined by the Mix_Rate, and as the Mix_Rate becomes 0, the reliability of Equation 1 is determined by the color similarity C_Sim. In other words, as the mixed rate of the color in the image region is increased, it means that the colors are uniformly distributed, and the color of the region may be visually recognized as one color by human eyes. In this case, the reliability of the representative color value is largely affected by the mixed rate Mix_Rate, and as the mixed rate of the colors is decreased, the reliability of the representative color value is largely affected by the color similarity C_Sim.

The color similarity C_Sim is obtained by the method as shown in Figure 3, and as shown in Figure 5, the mixed rate of the colors Mix_Rate is obtained using a ratio that each color occupies in the image region with respect to all

colors of the image region and an expansion rate which represents that each color is mixed with other colors.

The method for obtaining the mixed rate of the colors will be explained with refernece to Figure 5.

The portion Ci that the pixel having each color Ci occupies in the image with respect to all colors in the image is obtained. For example, in the case of a red color, the portion(Red) = (the total number of pixels of the red color)/(the total number of the pixels in the image). Thereafter, the expansion rate Ci is obtained with respect to each color. Results obtained by multiplying two values with respect to all colors in the image are summed for thereby obtaining the mixed rate Mix_Rate of the colors as follows:

Namely, the mixed rate $Mix\_Rate = \sum_{i=1}^{n} Portion(Ci) \times Expansion\_Rate(Ci)$ ---- (2)

where n represents the total number of colors in the image.

The method for obtaining the expansion rate with respect to each color in the image region will be explained with refernece to Figures 7 and 8. The expansion rate Ci with respect to each color Ci is obtained as follows.

$$Expansion\_Rate(Ci)=Expansion(Ci)/Max\_Expansion(Ci)$$

where Max_Expansion(Ci) represents the maximum expansion value determined based on an esize and the image region as follows, and the esize represents a value which is in proportion to the size of the expansion mask.

Max_Expansion(Ci)= ME(Ci); if Me(Ci)<the size of the image region

Max_Expansion(Ci)=the size of the image region; if ME(Ci) ≥the size of the image region.

ME(Ci)=(4esize^2+4esize+1)x(the number of the pixels having the color Ci in the image region), where esize=(Width of Expansion_Mask-1)/2, and the width(=height) of the Expansion_Mask is an odd number.

The esize is a value proportional to the size of the expansion size and a value for obtaining the degree of the effect that a certain pixel influences.

The Expansion(Ci) is obtained by the following sequence.

(a) The esize is determined. Here, the esize is a value proportional to the size of the Expansion_Mask(701 of Figure 7, and 801 of Figure 8) and represents a degree of a range that a certain pixel influences.

(b) The number of the pixels having a corresponding color Ci in the image region is obtained.

(c) The expansion_Mask is overlapped with respect to all pixels in the image region, and it is searched whether or not corresponding color exists in the mask, and a mask center cell is a corresponding color as shown in Figures 7 and 8. If a corresponding color does not exist in the mask, and the mask center cell does not have a corresponding color, the expansion(Ci) value is increased by +1. For example,in the Fig.8 in the case that the expansion is obtained with respect to the color representing as "C3", since the center cell of the mask is not the color "C3", and the color "C3" exists in the remaining mask regions except for

the center cell of the mask, +1 is added to the Expansion(C3) value.

(d) The above-descried operation is performed with respect to all image regions, and the Expansion(Ci) obtained as a result of the above-described operation is added to the number of the pixels having a corresponding color for thereby finally setting the Expansion(Ci) value.

Figure 7 is a view in which the Expansion_Mask 701 having the width and height of 5 and the esize of 2 is moved at every one pixel 703 in the image region, and figure 8 is a view in which the Expansion_Mask 801 is adapted to one pixel 803 in the image region 802. The numerals indicated in each pixel represent the color value of each pixel.

When the Expansion_Rate, Mix-Rate, color similarity values are obtained, it is possible to obtain a reliability as shown in Figure 4.

The method for designating a representative color using the thusly obtained reliability will be explained with reference to Figure 9.

The reliability value obtained by the method as shown in Figures 2 through 8 is compared with a threshold value(hereinafter, called as a threshold value 1). As a result of the comparison, if the reliability value is larger than the threshold value 1, namely, if it is possible to express the image region using one representative value, the average of all color values of the image region is designated as a representative color value.

However, if the reliability is smaller than the threshold value 1, designating the average color of the image region as a representative color of the region is inaccurate, another method is adapted.

In the case that the reliability is smaller than the threshold value 1, a frequency of the pixels in which the chrominance exceeds a certain level in the

image region is obtained. The method for obtaining the frequency of the pixels which have a chrominance exceeding a certain degree is shown in Figure 6. As shown in Figure 6, a chrominance element is extracted from each pixel with respect to all pixels in the image region, and then the number of the pixels having a chrominance exceeding a certain level is obtained, and the number of the pixels is divided by the number of the pixels in all image regions for thereby obtaining a frequency(hereinafter called as a chrominance color portion) of the pixels having a chrominance exceeding a certain degree. As a result of comparing the chrominance color portion with a certain threshold value(hereinafter called as a threshold value 2), if the chrominance color portion is smaller than the threshold value 2, it means that a clear color which represents an image region does not exist. Therefore, the average color of the image region is designated as a representative color.

As a result of the comparison, if the chrominance color portion is larger than the threshold value 2, it means that a clear color which is a representative of the image region exists, the representative color is designated as follows.

A hue element is extracted from the color of each pixel with respect to all pixels of the image region, and then is quantized for thereby forming a HUE histogram. The HUE histogram is formed by a descending series, and then the bin value is summed in the bin sequence having the larger values. The summing operation is performed until the summed value exceeds a certain threshold value(hereinafter called as a threshold value 3). When the summed result is larger than the threshold value 3, the color set corresponding to the summed bin is assumed as a HUE_SET, and an average of the pixel values in a corresponding image is obtained. The thusly obtained value is designated as a

representative color.

Figure 10 is a flow chart of a method for designating a representative color value using a reliability which is different from the embodiment of Figure 9. This method will be explained. If the reliability is smaller than the threshold value 3, a hue histogram is obtained, and the above-described process is performed with respect to all colors Ci. The hue(hi) of a certain color Ci is obtained, and the cases that the thusly obtained hue(hi) is larger is counted, and then the average value C av h of the color Ci is computed. The above-described operation is repeatedly performed until the final pixel in the image. When the final pixel is computed, in the case that there is not a hue(hi) value which is larger than a threshold value 4, namely, in the case that the count value is 0, the value obtained by averaging all colors in the image region is designated as a representative value. In the case that the count value is not 0, namely, if there is at least one hue(hi) value larger than the threshold value 4, the average value of the colors having a hue(hi) value larger than the threshold value 4 is designated as a representative color with respect to the region.

Figure 11 is a view illustrating a representative color expression method of a 8x8 grid region formed of 64 local cells which are expressed by a reliability with respect to the representative color value in the image region. Namely, a color information is expressed based on a representative color value Cij and a reliability Sij of the local cell.

Figure 12 us a view illustrating a sequence for segmenting an image region into grids and designating a representative color value with respect to each local cell. It is possible to implement a reliable image processing by segmenting an image region into local cells and expressing a reliability as well

as a representative color which is expressed as a representative cell with respect to each local cell.

Figure 13 is a view illustrating an adaptation of the method of Figure 12 and a comparison by segmenting the images G1 and G2 into grids as shown in Figure 11 and expressing a representative color and reliability with respect to each local cell when comparing two images G1 and G2 having a nxm size.

Namely, the color similarities C_Sim(C1ij, C2ij) and reliability S1ij, S2ij of the local cells corresponding to each local cell of the images G1 and G2 are obtained, and the similarities RC_Sim(G1, G2) of two image regions G1, G2 are determined by multiplying the color similarity and reliability. Here, C1ij represents a representative color value with respect to the local cell (i,j) of the image G1, and S1ij represents a reliability with respect to the representative color of the local cell (i,j). In addition, in the color similarities C_Sim(C1ij,C2ij), the local cell(i,j) of the image G1 and the local cell(i,j) of the image G2 may be expressed as a distance difference in the color coordinate space between C1ij and C2ij. Any type of color coordinate space may be used. As the color coordinate space is uniformly changed, the value obtained based on the color coordinate space becomes accurate.

The similarities RC_Sim(G1, G2) between two image regions G1 and G2 having a nxm size may be obtained based on a weight in accordance with a reliability value. The following is an example of the above-described method.

$$RC\_Sim(G1,G2)=\{\sum_{i=1}^{n}\sum_{j=1}^{m}[axS1ijxS2ijxC\_Sim(C1ij,C2ij)+bx(1-(S1ij-S2ij)]^2 /$$

[(nxm)x(a+b)]}

where a, b represent weights based on a reliability, and it is possible to obtain a similarity between two image regions by adjusting the values a and b.

Next, the method that a color segmentation is performed for segmenting the region formed of the same colors using the reliability will be explained.

It is possible to perform a color segmentation using the reliability by recognizing the case that the value of the reliability exceeds a certain level as the same color even when the colors are not the same.

Figure 15 illustrates the above-descried color segmentation method, and Figure 14 illustrates a quad tree for dividing the image into four parts.

Namely, the reliability of the image region is obtained, and the image region in which the reliability is below a certain threshold value(hereinafter called as a threshold value 5) is segmented into four parts for thereby obtaining a representative color and reliability.

The reliability of each of divided four region is compared with the threshold value 5, and the region having a threshold value below 5 is segmented into four parts. The above-described operation repeatedly performed until the reliability of all regions exceed 5. Therefore, in this case, since all segmented regions have a reliability of above 5, the above-descried sub-regions may be recognized as one color.

In other words, the entire images or a certain region designated by a user are expressed by a quad tree method, and each region of the quad tree is expressed as a representative color and reliability. The above-described quad tree type region segmentation is repeatedly performed until all regions have a

threshold value above a certain degree.

As described above, in the present invention, the representative color value of the image region is expressed together with the reliability, so that the weight is determined based on the reliability during the image search. When measuring the color similarity between two images, it is possible to accurately measure the color similarity using the reliability for thereby enhancing an image search performance.

In addition, in the present invention, the representative color values of the image region are expressed together with the reliability, so that it is possible to more effectively perform a color segmentation in accordance with the degree of the reliability when performing a color segmentation in which the image region is segmented into sub-regions for thereby displaying the colors based on the same color.

Although the preferred embodiment of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as recited in the accompanying claims.

What is claimed is:

1. In a method using a color value as information with respect to an image region, a representative color designating method, comprising:

a step for expressing a reliability of the representative color value as color information of the image region together with a representative color value which represents the image region.

2. The method of claim 1, wherein said reliability is directed to a degree that an image region is expressed by one color which represents the region.

3. The method of claim 2, wherein said reliability is determined based on a mixed rate and a color similarity of the image region.

4. The method of claim 3, wherein said method for obtaining the reliability includes:

a step for averaging a color value of the image region and removing the elements of the mixed rate; and

a step for obtaining a color similarity of the image region and setting the color similarity as a reliability of the image region.

5. The method of claim 3, wherein said method for obtaining a reliability includes:

a step for obtaining a mixed rate of colors;

a step for obtaining a color similarity; and

a step for setting a mixed rate of the colors and a reliability value in accordance with the color similarity.

6. The method of claim 5, wherein said reliability is set based on the following expression:

Reliability=mixed rate of colors+(1-mixed rate of colors)x color similarity

7. The method of claim 3, wherein said method for obtaining the color similarity includes:

a step for obtaining an average value of the colors of all pixels of an image region;

a step for obtaining hue, light, chrominance elements with respect to the average value; and

a step for obtaining hue, light and brightness elements with respect to each pixel of the image region and using a result obtained by summing the distance values in the color coordinate space of the hue, light and chrominance elements of the pixels and the hue, light and chrominance elements of the average value as a color similarity.

8. The method of claim 7, wherein said third step further includes a step in which a result obtained by summing the distance values in the color coordinate space of the hue, light and chrominance elements of each pixel in the image region and the hue, light and chrominance elements of the average value is normalized, and then a result obtained by subtracting the normalized from 1 is

determined as a color similarity.

9. The method of claim 3, wherein said method for obtaining a mixed rate of the colors of the image region includes:

a step for obtaining a color portion which is a ratio that the pixels having the colors with respect to a certain color of the image region occupy in the image region;

a step for obtaining an expansion rate which represents a degree that the colors are mixed with other colors in the image region;

a step for multiplying the color portion and the expansion rate; and

a step for performing the above-described steps with respect to all colors in the image region, summing for all values from said performance and determining the obtained values as a mixed rate of the colors.

10. The method of claim 9, wherein said color portion of the colors is determined by dividing the number of the pixels having a certain color by the total number of the pixels in the image region.

11. The method of claim 9, wherein said method for obtaining an expansion rate of the colors includes:

a first step for obtaining the number of pixels having a certain color in an image region;

a second step for over-lapping the center cells of the expansion mask having a certain size onto one pixel in the image region and checking the overlapped state, namely, checking whether the center cell of the expansion

mask is not a certain color value but is a certain color in the region of the expansion mask;

a third step for performing the second step with respect to all pixels in the image region and summing +1 when the overlapped states of the second step are satisfied;

a fourth step for summing a result of the first step and a result of the third step and obtaining an expansion result with respect to the color; and

a fifth step for obtaining an esize value set based on the size of the expansion mask and a maximum expansion value which is determined based on the characteristic of the image and determining a rate between the expansion value and the maximum expansion value as an expansion rate with respect to a certain color.

12. The method of claim 11, wherein said method for obtaining a maximum expansion value with respect to a certain color includes:

a first step for obtaining a pixels having a certain color which exists in the size of (expansion mask x expansion mask);

a second step for comparing a result value of the first step and a size of the image region;

a third step for determined the size of the image region as a maximum expansion value in the case that the size of the image region is larger as a result of the second step; and

a fourth step for determining a result value of the first step as a maximum expansion value with respect o the color in the case that the result value is larger as a result of the comparison of the second step.

13. The method of claim 12, wherein said expansion mask is a square shape formed of an odd number of pixels, and the value of the esize is set based on (width of expansion mask-1)/2.

14. The method of claim 3, wherein said representative color value of the image region is determined based on a result obtained by comparing the reliability with a threshold value 1.

15. The method of claim 14, wherein a representative color of the image region is determined as an average value of all color values in the image region in the case that the reliability is larger than the threshold value 1 as a result of the comparison.

16. The method of claim 14, wherein said method for designating a representative color of the image region in the case that the reliability is smaller than the threshold value 1 as a result of the comparison includes:

a first step for obtaining a portion of the pixels in which the chrominance exceeds a certain degree in the image region;

a second step for extracting a hue element from the color of the pixel with respect to all pixels in the image region in the case that a result of the first step is larger than a threshold value 2 and forming a hue histogram;

a third step for summing the hue histogram in a bin sequence of the larger value and summing until a result of the summing operation exceeds a threshold value 3; and

a fourth step for designating an average of the color set having above threshold value 3 as a representative color as a result of the summing operation of the fourth step.

17. In a method for using a color value as an information with respect to an image region, a local representative color designation method, comprising the steps of:

segmenting an image region into nxm local regions; and

expressing a reliability of the representative color value as a color information of a corresponding cell together with a representative color which represents each segmented local cell.

18. In a method for comparing similarities of images, a similarity measuring method of an image using a reliability, comprising the steps of:

expressing a reliability of a representative color value as an information of a corresponding image region together with a representative color which represents an image region;

comparing the reliability of the images; and

judging the similarities of the images in accordance with the reliability.

19. The method of claim 18, wherein when measuring a similarity of the image, the reliability is used as a weight.

20. A color segmentation method for segmenting an image into regions having the same color, comprising:

a first step for expressing a reliability of a representative color as a color information of a corresponding image region together with a representative color which represents an image;

a second step for comparing a reliability of the image region with a threshold value 5 and segmenting a corresponding image region when a result of the comparison is below the threshold value 5; and

a third step for repeatedly performing the second step until the reliability of all segmented regions exceed the threshold value 5.

21. The method of claim 20, wherein said image region is expressed using a quad tree, and each node of the quad tree represents a segmented region, and said region is expressed by a representative color and reliability value, and each node is segmented until the reliability value exceeds the threshold value 5.

FIG. 1

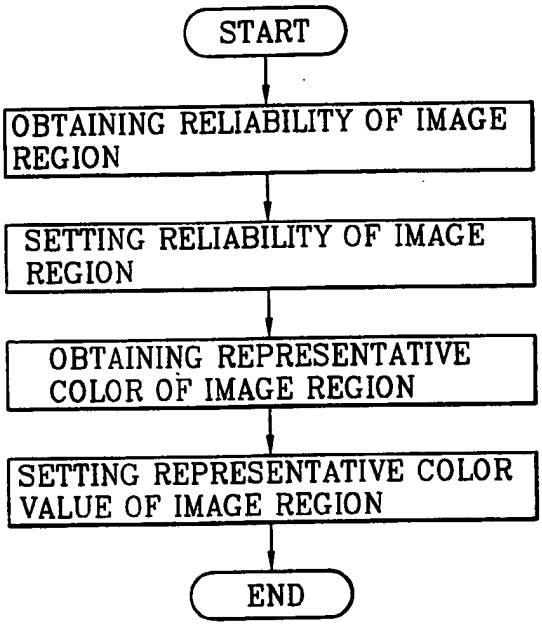

START
OBTAINING RELIABILITY OF IMAGE REGION
SETTING RELIABILITY OF IMAGE REGION
OBTAINING REPRESENTATIVE COLOR OF IMAGE REGION
SETTING REPRESENTATIVE COLOR VALUE OF IMAGE REGION
END

FIG. 2

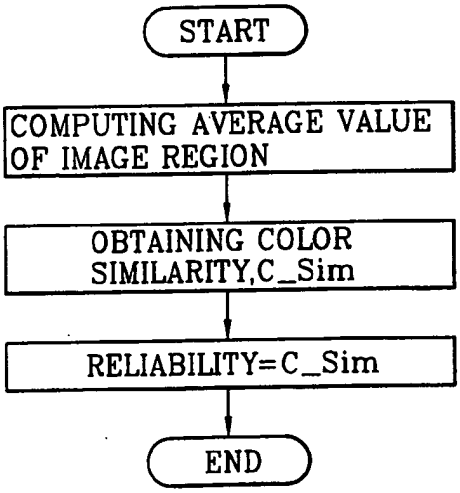

START
COMPUTING AVERAGE VALUE OF IMAGE REGION
OBTAINING COLOR SIMILARITY,C_Sim
RELIABILITY=C_Sim
END

FIG. 3

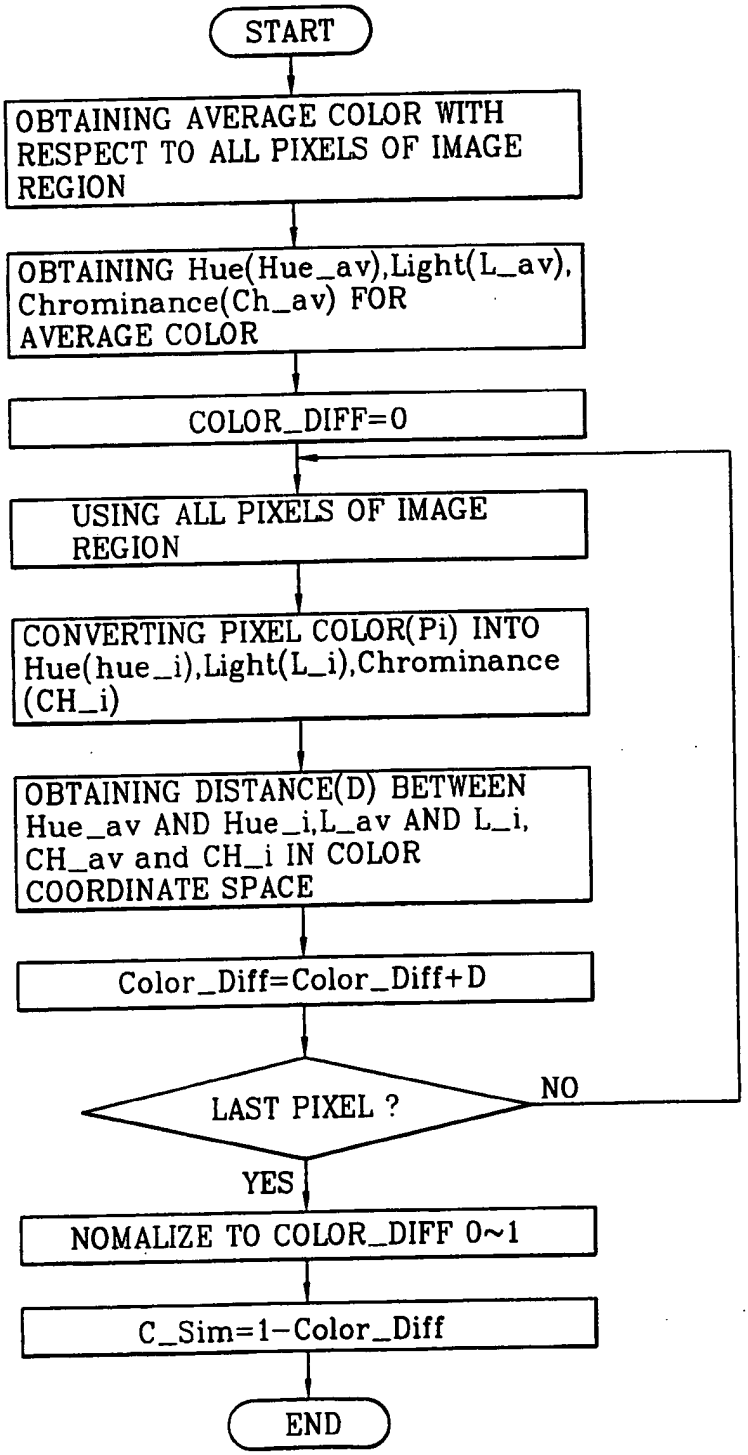

START
OBTAINING AVERAGE COLOR WITH RESPECT TO ALL PIXELS OF IMAGE REGION
OBTAINING Hue(Hue_av),Light(L_av), Chrominance(Ch_av) FOR AVERAGE COLOR
COLOR_DIFF=0
USING ALL PIXELS OF IMAGE REGION
CONVERTING PIXEL COLOR(Pi) INTO Hue(hue_i),Light(L_i),Chrominance (CH_i)
OBTAINING DISTANCE(D) BETWEEN Hue_av AND Hue_i,L_av AND L_i, CH_av and CH_i IN COLOR COORDINATE SPACE
Color_Diff=Color_Diff+D
LAST PIXEL ?
NO
YES
NOMALIZE TO COLOR_DIFF 0~1
C_Sim=1-Color_Diff
END

FIG. 4

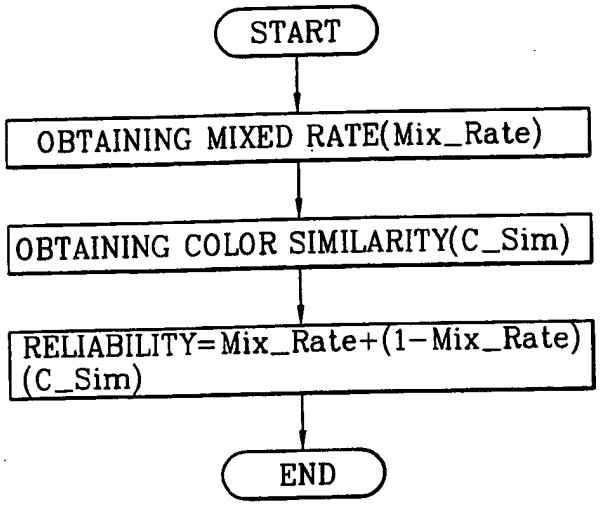

START
OBTAINING MIXED RATE(Mix_Rate)
OBTAINING COLOR SIMILARITY(C_Sim)
RELIABILITY=Mix_Rate+(1-Mix_Rate)(C_Sim)
END

FIG. 5

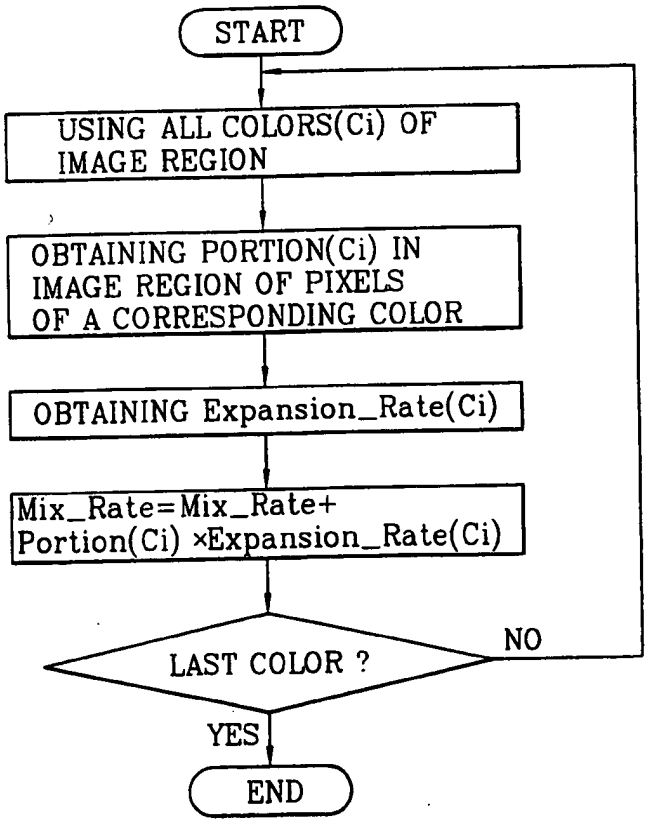

START
USING ALL COLORS(Ci) OF IMAGE REGION
OBTAINING PORTION(Ci) IN IMAGE REGION OF PIXELS OF A CORRESPONDING COLOR
OBTAINING Expansion_Rate(Ci)
Mix_Rate=Mix_Rate+Portion(Ci) ×Expansion_Rate(Ci)
LAST COLOR ?
NO
YES
END

FIG. 6

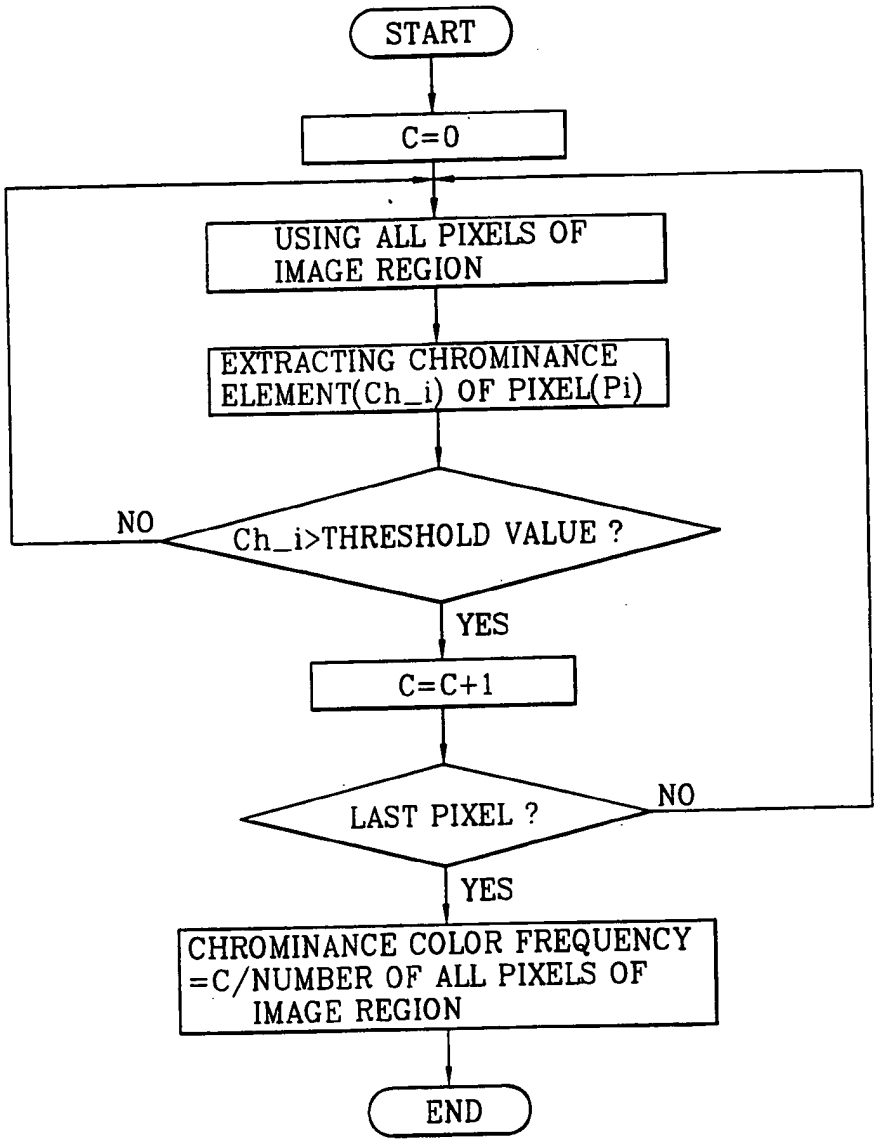

START
C=0
USING ALL PIXELS OF IMAGE REGION
EXTRACTING CHROMINANCE ELEMENT(Ch_i) OF PIXEL(Pi)
Ch_i>THRESHOLD VALUE ?
NO
YES
C=C+1
LAST PIXEL ?
NO
YES
CHROMINANCE COLOR FREQUENCY =C/NUMBER OF ALL PIXELS OF IMAGE REGION
END

FIG. 7

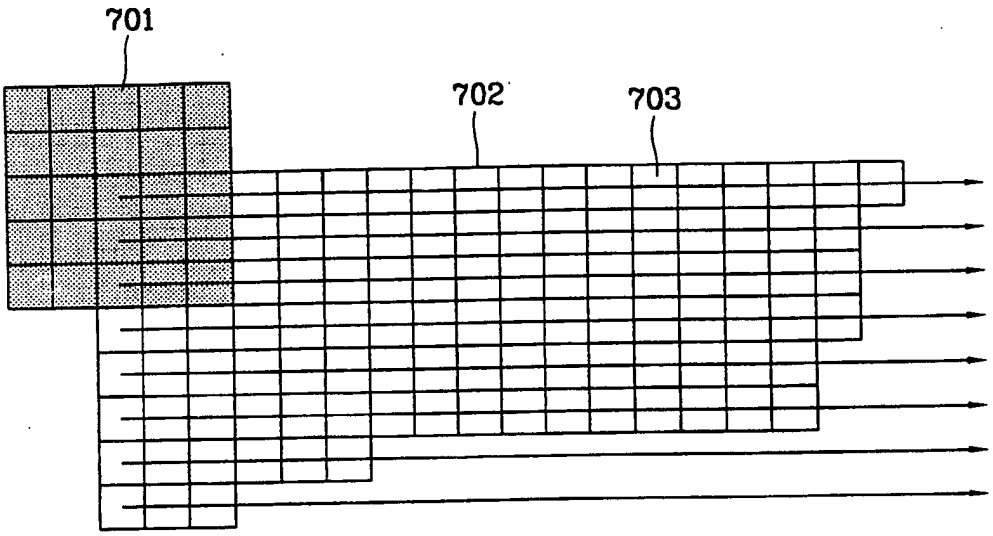

701
702
703

FIG. 8

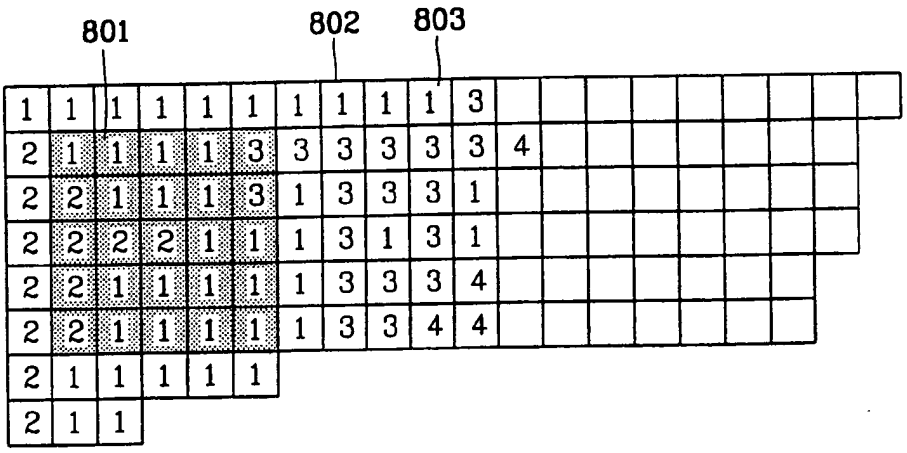

801
802
803
1 1 1 1 1 1 1 1 1 1 3
2 1 1 1 1 3 3 3 3 3 3 4
2 2 1 1 1 3 1 3 3 3 1
2 2 2 2 1 1 1 3 1 3 1
2 2 1 1 1 1 1 3 3 3 4
2 2 1 1 1 1 1 3 3 4 4
2 1 1 1 1 1
2 1 1

FIG. 9

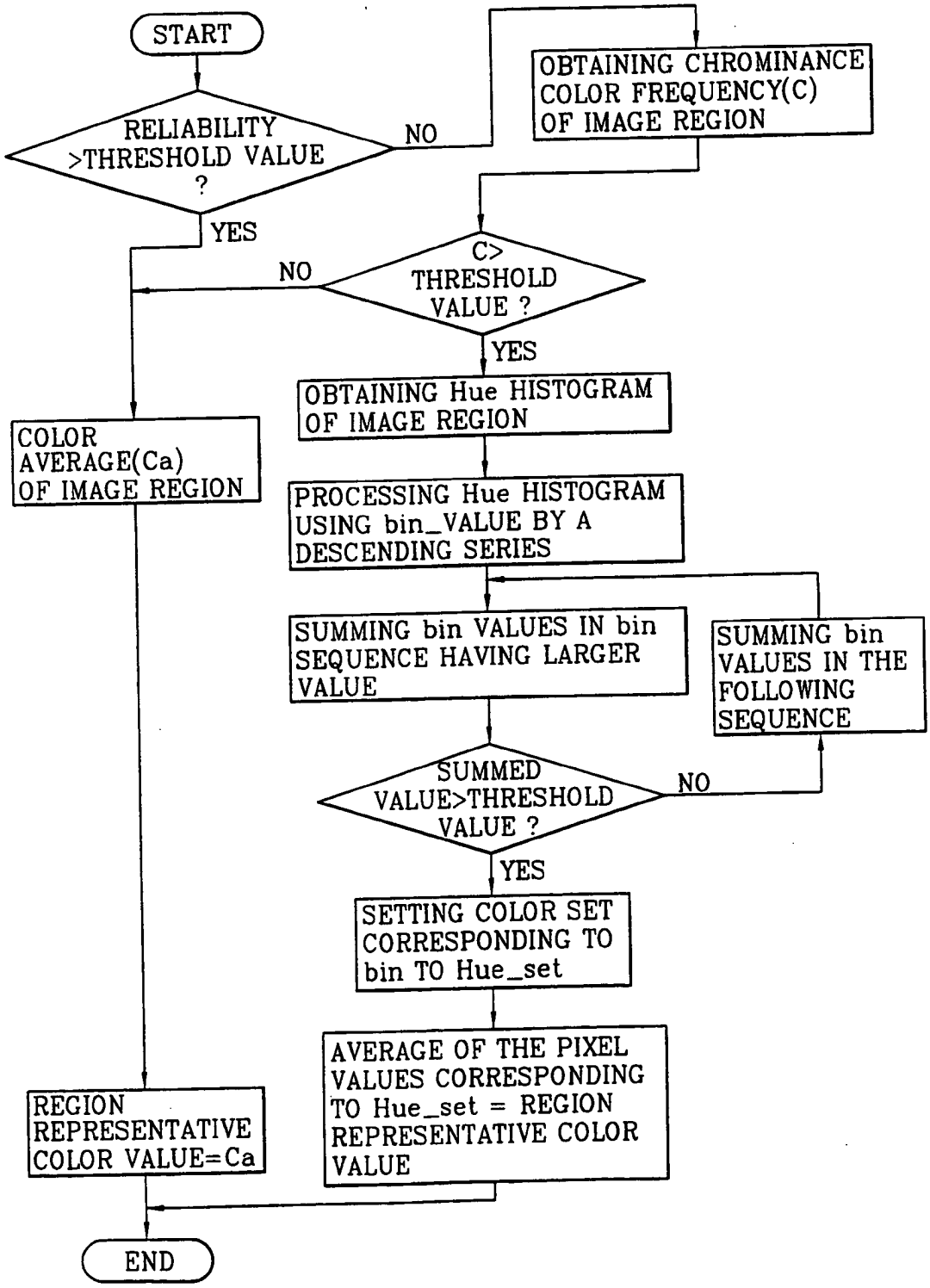

START
RELIABILITY >THRESHOLD VALUE ?
NO
YES
OBTAINING CHROMINANCE COLOR FREQUENCY(C) OF IMAGE REGION
C> THRESHOLD VALUE ?
NO
YES
COLOR AVERAGE(Ca) OF IMAGE REGION
OBTAINING Hue HISTOGRAM OF IMAGE REGION
PROCESSING Hue HISTOGRAM USING bin_VALUE BY A DESCENDING SERIES
SUMMING bin VALUES IN bin SEQUENCE HAVING LARGER VALUE
SUMMING bin VALUES IN THE FOLLOWING SEQUENCE
SUMMED VALUE>THRESHOLD VALUE ?
NO
YES
SETTING COLOR SET CORRESPONDING TO bin TO Hue_set
AVERAGE OF THE PIXEL VALUES CORRESPONDING TO Hue_set = REGION REPRESENTATIVE COLOR VALUE
REGION REPRESENTATIVE COLOR VALUE=Ca
END

FIG. 10

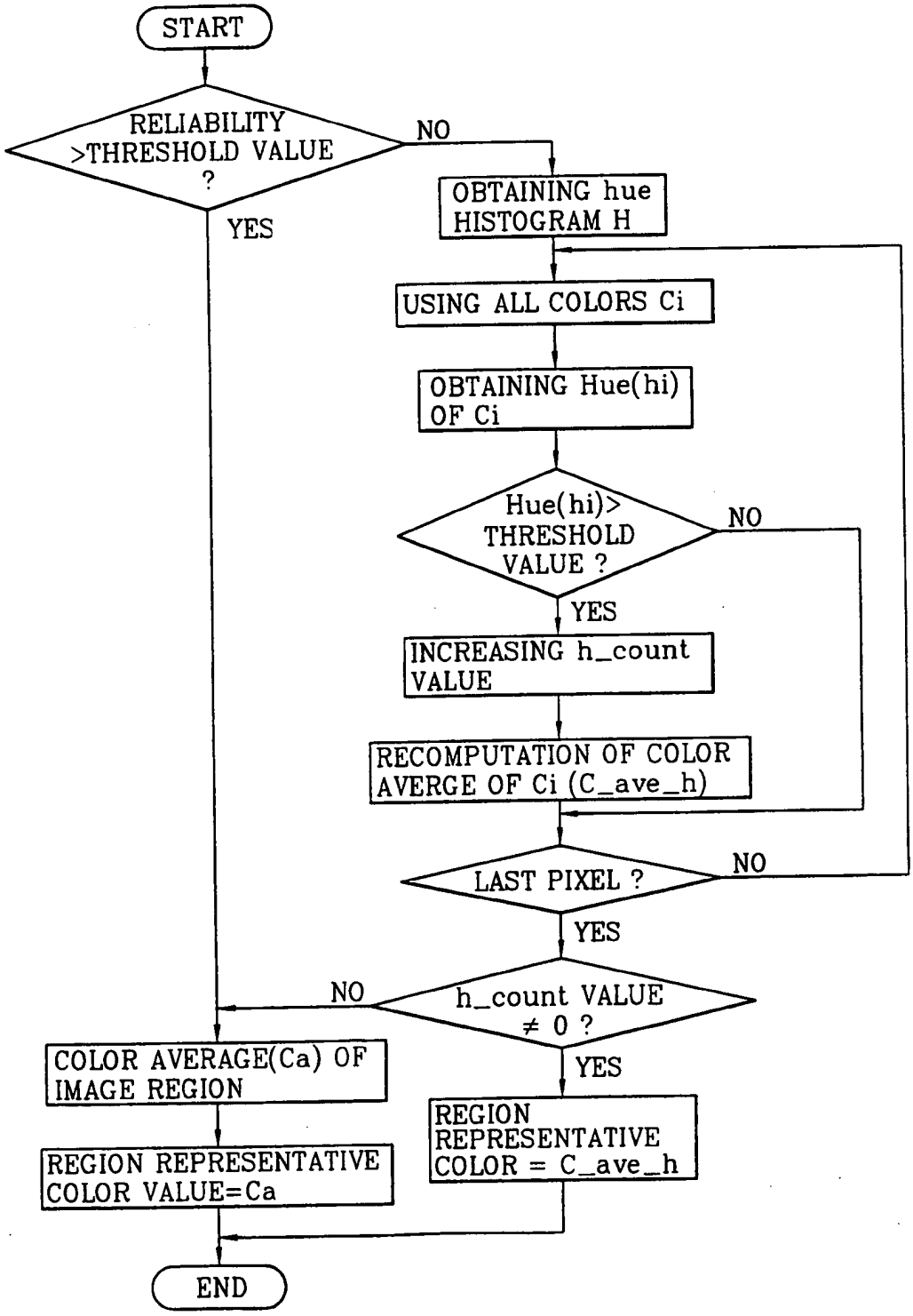

START
RELIABILITY >THRESHOLD VALUE ?
NO
YES
OBTAINING hue HISTOGRAM H
USING ALL COLORS Ci
OBTAINING Hue(hi) OF Ci
Hue(hi)> THRESHOLD VALUE ?
NO
YES
INCREASING h_count VALUE
RECOMPUTATION OF COLOR AVERGE OF Ci (C_ave_h)
LAST PIXEL ?
NO
YES
h_count VALUE ≠ 0 ?
NO
YES
COLOR AVERAGE(Ca) OF IMAGE REGION
REGION REPRESENTATIVE COLOR VALUE=Ca
REGION REPRESENTATIVE COLOR = C_ave_h
END

FIG. 11

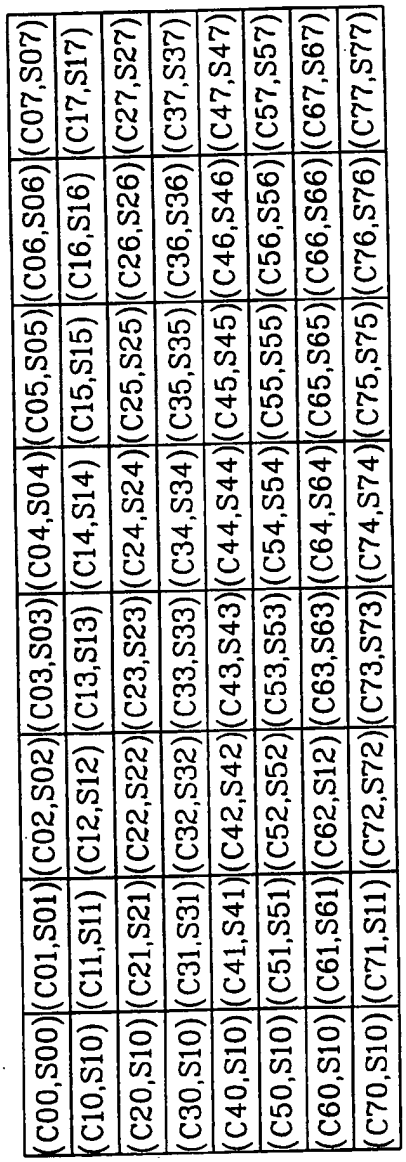

(C00,S00) (C01,S01) (C02,S02) (C03,S03) (C04,S04) (C05,S05) (C06,S06) (C07,S07)
(C10,S10) (C11,S11) (C12,S12) (C13,S13) (C14,S14) (C15,S15) (C16,S16) (C17,S17)
(C20,S10) (C21,S21) (C22,S22) (C23,S23) (C24,S24) (C25,S25) (C26,S26) (C27,S27)
(C30,S10) (C31,S31) (C32,S32) (C33,S33) (C34,S34) (C35,S35) (C36,S36) (C37,S37)
(C40,S10) (C41,S41) (C42,S42) (C43,S43) (C44,S44) (C45,S45) (C46,S46) (C47,S47)
(C50,S10) (C51,S51) (C52,S52) (C53,S53) (C54,S54) (C55,S55) (C56,S56) (C57,S57)
(C60,S10) (C61,S61) (C62,S12) (C63,S63) (C64,S64) (C65,S65) (C66,S66) (C67,S67)
(C70,S10) (C71,S11) (C72,S72) (C73,S73) (C74,S74) (C75,S75) (C76,S76) (C77,S77)

FIG. 12

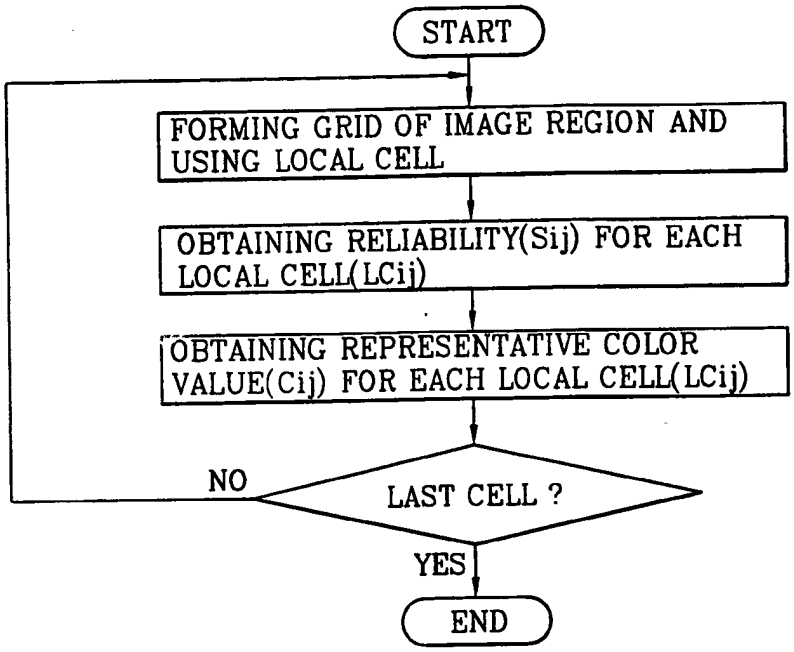

START
FORMING GRID OF IMAGE REGION AND USING LOCAL CELL
OBTAINING RELIABILITY(Sij) FOR EACH LOCAL CELL(LCij)
OBTAINING REPRESENTATIVE COLOR VALUE(Cij) FOR EACH LOCAL CELL(LCij)
NO
LAST CELL ?
YES
END

FIG. 13

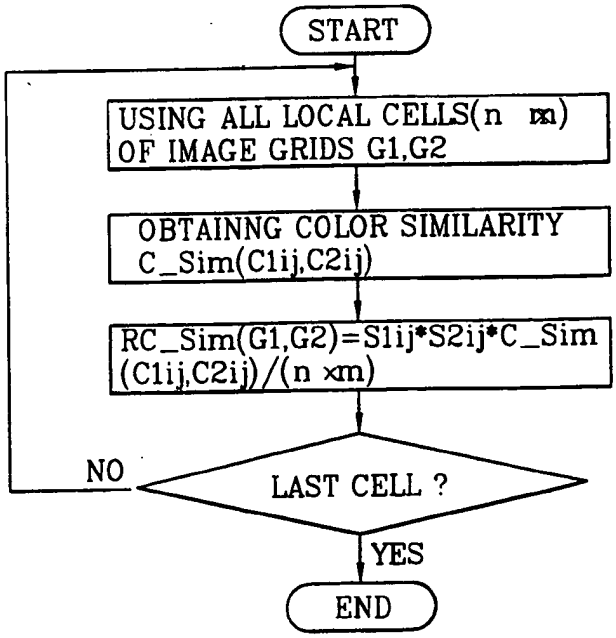
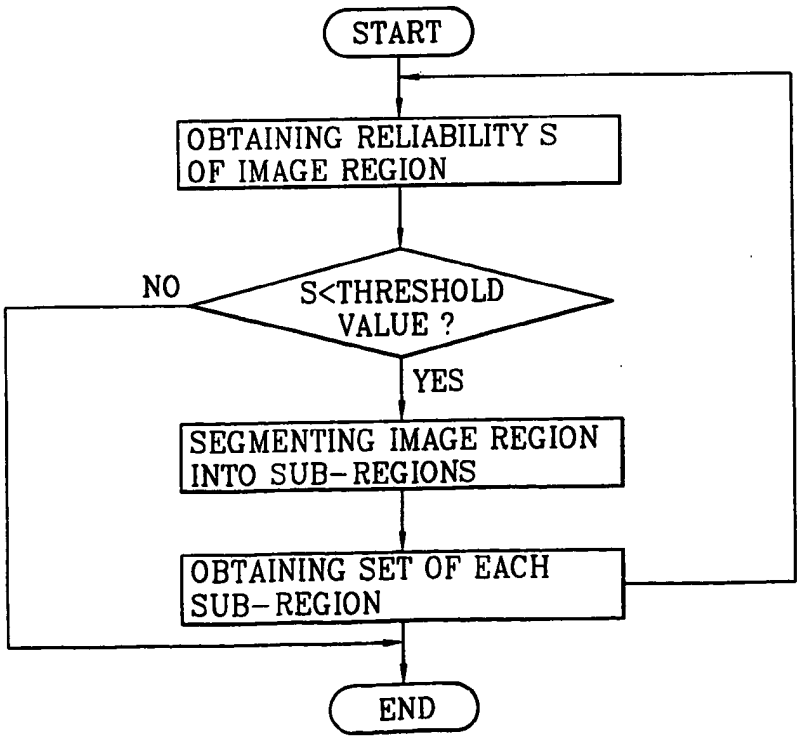

START
USING ALL LOCAL CELLS(n m) OF IMAGE GRIDS G1,G2
OBTAINNG COLOR SIMILARITY C_Sim(C1ij,C2ij)
RC_Sim(G1,G2)=S1ij*S2ij*C_Sim (C1ij,C2ij)/(n ×m)
NO
LAST CELL ?
YES
END

FIG. 14

<table>
<tr><td rowspan="2">(C0,S0)</td><td colspan="2">(C10,S10)</td><td>(C11,S11)</td></tr>
<tr><td colspan="2">(C12,S12)</td><td>(C13,S13)</td></tr>
<tr><td rowspan="3">(C2,S2)</td><td>(C300,S300)</td><td>(C301,S301)</td><td rowspan="2">(C31,S31)</td></tr>
<tr><td>(C302,S302)</td><td>(C303,S303)</td></tr>
<tr><td colspan="2">(C32,S32)</td><td>(C33,S33)</td></tr>
</table>

FIG. 15



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR99/00849

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G06T 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC7 G06T 1/00, G06F 17/30, G06T 7/00

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

Korean patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

WPI, PAJ, IEEE/IEE Electronic Library (Since 1988) "COLOR", " SEGMENT", "RELIABILITY", "IMAGE"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-238077 A (MINOLTA CO., LTD) 31 August 1999 (31.03.1999) Claim 1-8	1-3, 14, 17-21
Y	KR 98-022999 A (DAEWOO ELECTRONICS CO.,LTD) 6 July 1998 (06. 07. 1998) The whole document	1-3, 14, 17-21
A	JP 11-031153 A (HITACHI, LTD) 2 February 1999 (02. 02. 1999) The whole document	1-8
A	JP 10-289242 A (ATR CHINOU EIZO TSUSHIN KENKYUSHO) 27 October 1998 (27. 10. 1998) Abstract, Fig.1	1-21

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevence
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 APRIL 2000 (12.04.2000)	14 APRIL 2000 (14.04.2000)

Name and mailing address of the ISA/KR	Authorized officer
Korean Industrial Property Office Government Complex-Taejon, Dunsan-dong, So-ku, Taejon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140	LEE, Jung Suk Telephone No. 82-42-481-5789

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